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Using Python Libraries from Delphi

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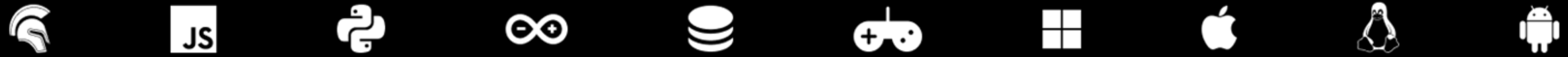
Embarcadero
Python Technical Blog Writer

learndelphi.org/boot-camp-2022

Who is this Session for?

- Delphi Developer who want to add powerful Python libraries into their program
- Python Developer who want to easily create Desktop or custom apps, outside the common Tkinter GUI, Jupyter, or Streamlit ecosystem
- Programmer/Tech Enthusiast who wants to witness the magic of combining 2 programming language giants

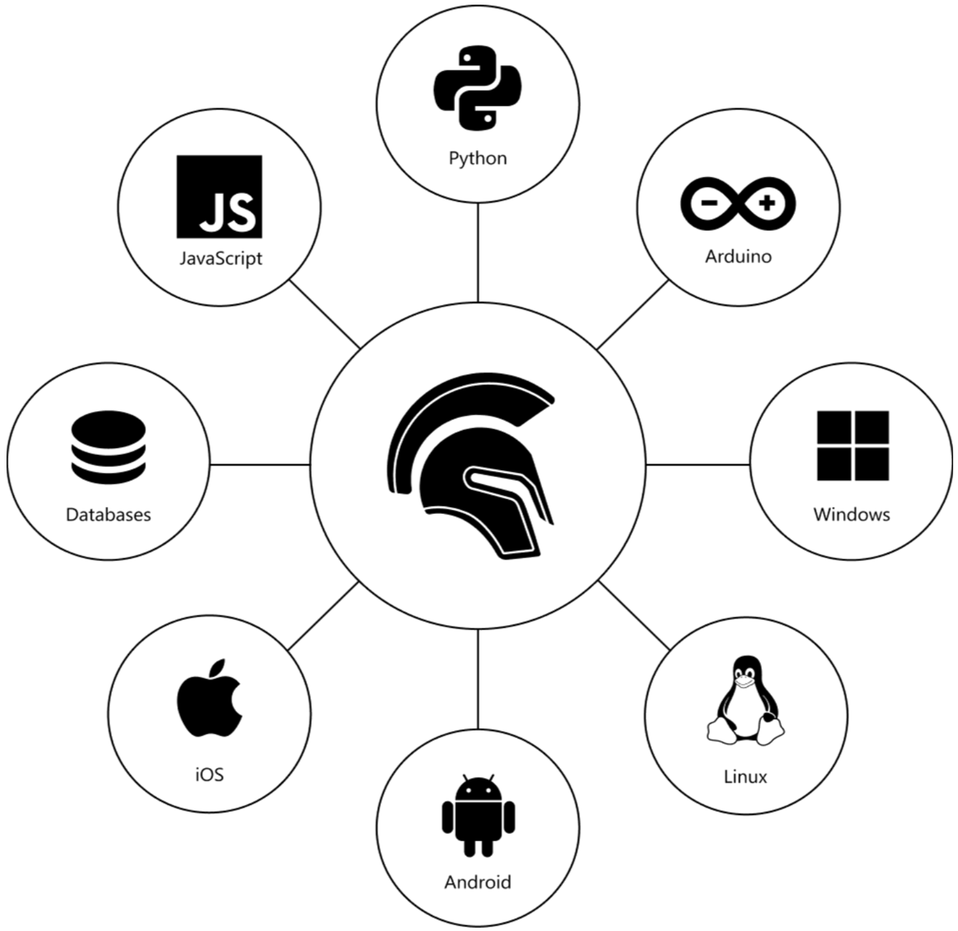


Goal of this Session

- Attract Python developers to use P4D to create GUIs and learn more about Delphi.
- Add Python Data Science library powers for Delphi developers.
- Inspire the open-source community to develop more advanced use cases using P4D.

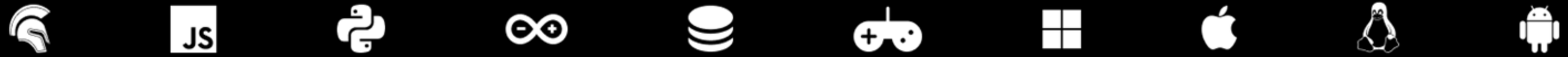
Agenda

- Philosophy of Delphi and Python
- Introduction to Python4Delphi
- Prerequisites
- Code & Demo 01: Scrapy4D
- Code & Demo 02: Matplotlib4D, Fastai4D, ScikitLearn4D, and NetworkX4D
- Code & Demo 03: Pandas4D
- Further Readings



Delphi’s DNA

1. **Developer productivity** – The main goal is getting things done quickly
2. **Maintainability** – Code is easy to read and understand with good encapsulation
3. **Fast compiled native apps** – Compiles fast, and native applications run fast
4. **Database access** – Always includes a rich set of database access components
5. **Platform API access** – You don’t need to call platform APIs, but can if you want
6. **Property-Method-Event** – General model for working with components
7. **Visual designers** – WYSIWYG with drag and drop interface
8. **Reliable applications** – Exception handling and component owner model
9. **Backwards compatibility** – Even with all the updates most code is compatible
10. **Rich component ecosystem** – There is usually a component for everything



The Zen of Python

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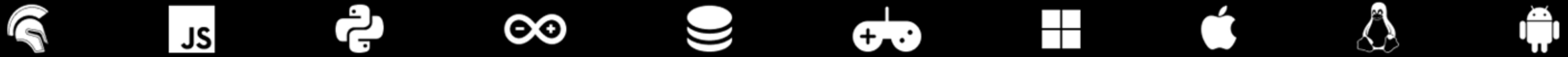
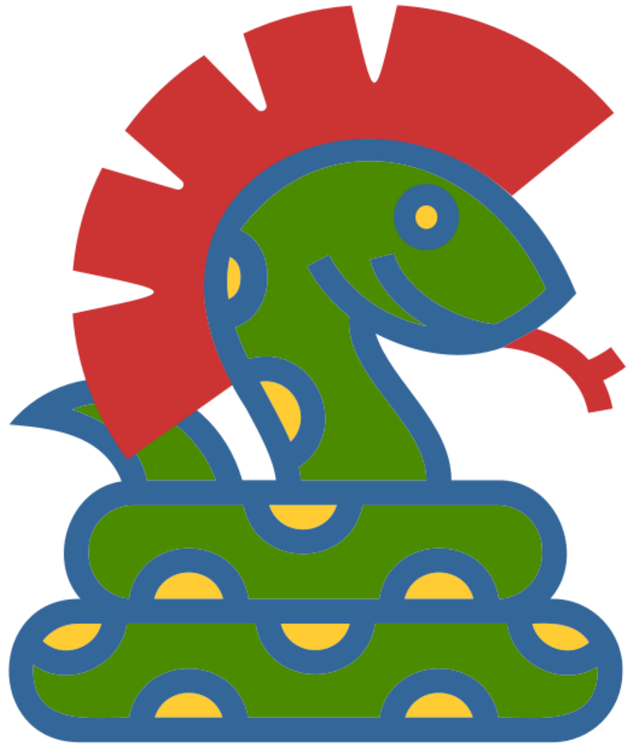
1. Beautiful is better than ugly.
2. Explicit is better than implicit.
3. Simple is better than complex.
4. Complex is better than complicated.
5. Flat is better than nested.
6. Sparse is better than dense.
7. Readability counts.
8. Special cases aren't special enough to break the rules.
9. Although practicality beats purity.
10. Errors should never pass silently.
11. Unless explicitly silenced.
12. In the face of ambiguity, refuse the temptation to guess.
13. There should be one-- and preferably only one --obvious way to do it.
14. Although that way may not be obvious at first unless you're Dutch.
15. Now is better than never.
16. Although never is often better than *right* now.
17. If the implementation is hard to explain, it's a bad idea.
18. If the implementation is easy to explain, it may be a good idea.
19. Namespaces are one honking great idea -- let's do more of those!



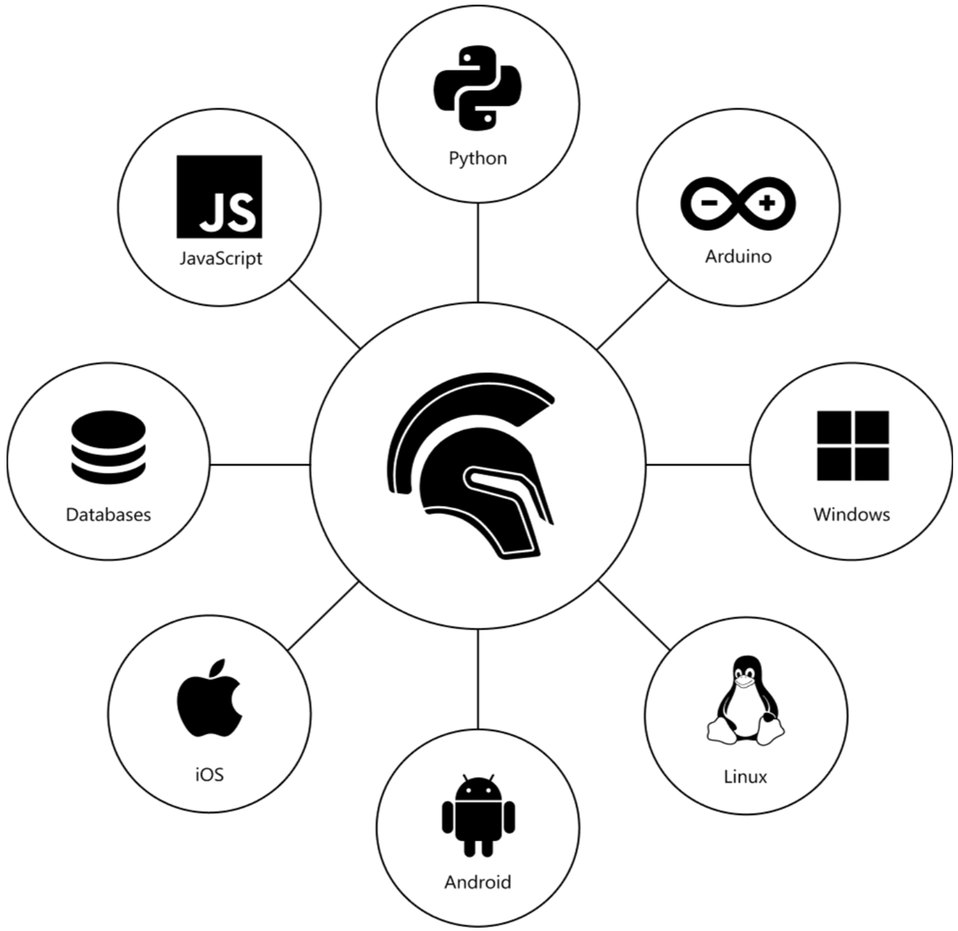
What is Python4Delphi

- Set of components that wrap up the Python DLL into Delphi and Lazarus (FPC).
- Delphi developers:
  - Execute Python scripts,
  - Create new Python modules and new Python types.
- Python developers:
  - Delphi's award-winning VCL functionalities for Windows
  - Modern GUI with Windows 10 looks and responsive controls for Python applications.



Prerequisites

- Beginner to intermediate knowledge in programming (especially in Delphi & Python) would help you a lot
- RAD Studio installed https://www.embarcadero.com/products/rad-studio/start-for-free
- Python installed
- Python4Delphi installed https://www.youtube.com/watch?v=hjY6lBgrHhM
- Installation of the following Python libraries:
  - Scrapy, Matplotlib, Fastai, scikit-learn, NetworkX, and Pandas



Prerequisites – Python Libraries

- Recommended practice - Using Anaconda distribution:

```
conda install -c conda-forge scrapy

conda install -c conda-forge matplotlib

conda install -c fastai -c pytorch -c anaconda -c
conda-forge fastai gh anaconda

conda install -c anaconda scikit-learn

conda install -c anaconda networkx
```

Scrapy

matplotlib

fast.ai

Making neural nets uncool again

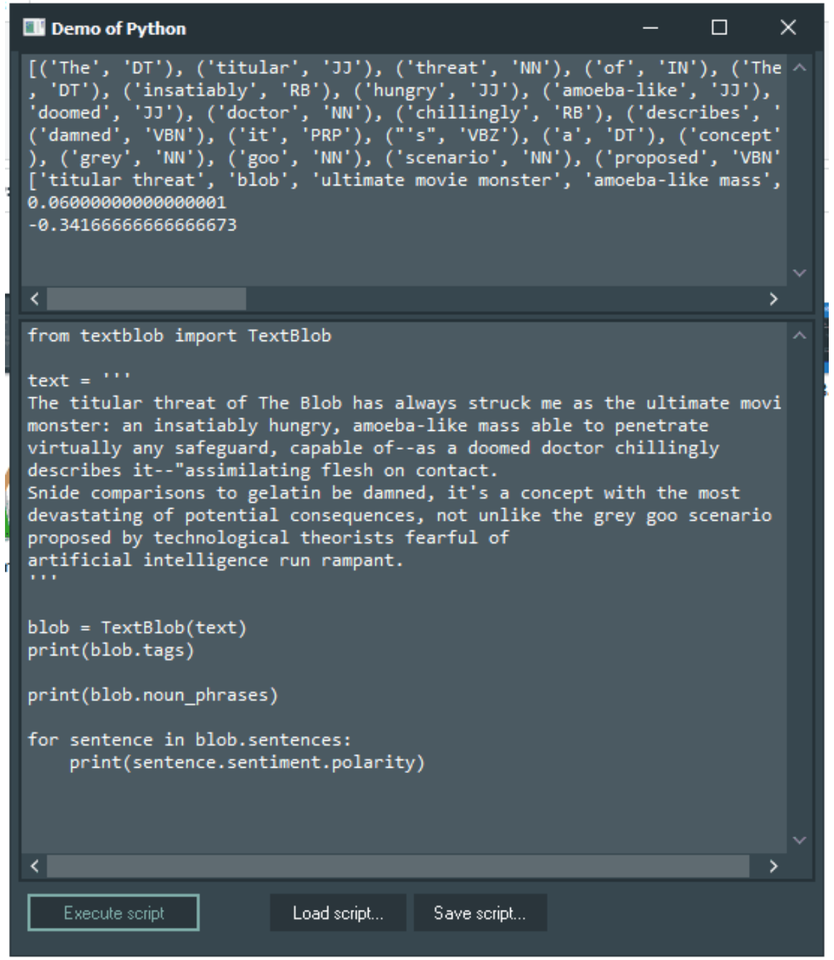
scikit learn

pandas

Main Idea

- To extend the existing Python4Delphi Demos
- Browse the existing demo here: https://github.com/pyscripter/python4delphi/tree/master/Demos (shown right: Example of Demo 01)

- What I've achieved in this first iteration:
  - All Python code is hidden/set up at the back-end.
  - Image and table output are shown inside the GUI.
  - Interchangeable between Python version & distributions (regular Python vs Anaconda distributions) to avoid complicated conflicts for some Python libs.



Demo 01: Scrapy4D

Scrapy

Scrapy Demo

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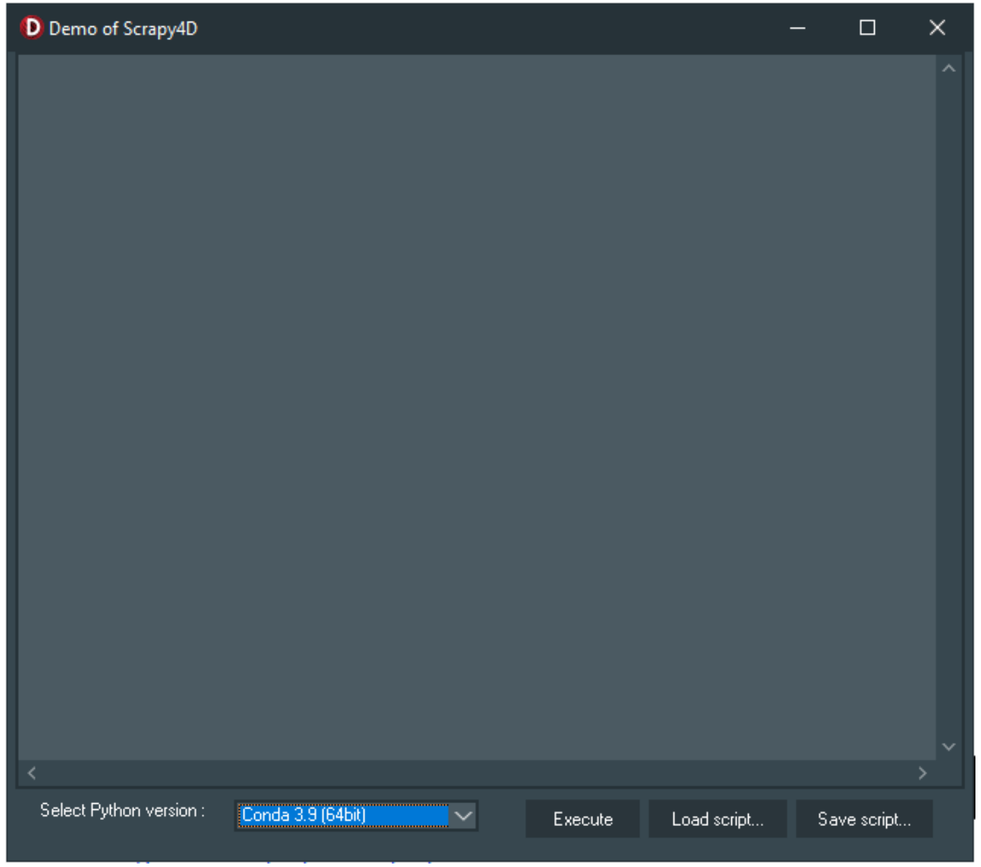
What is Scrapy?

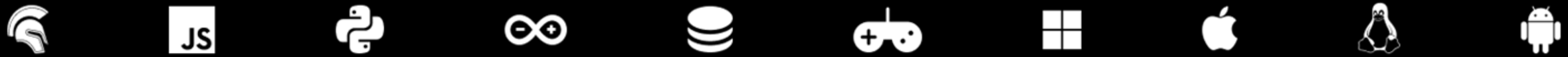
- Scrapy is a fast high-level web crawling and web scraping framework
- used to crawl websites and extract structured data from their pages.
- It can be used for a wide range of purposes: From data mining to monitoring and automated testing.

Scrapy Demo

List of components used in the Scrapy4D demo app:

1. TPythonEngine
2. TPythonModule
3. TPythonType
4. TPythonVersions
5. TPythonGUIInputOutput
6. TMemo
7. TOpenDialog
8. TSaveDialog
9. TSplitter
10. TPanel
11. TLabel
12. TComboBox
13. TButton





Scrapy Demo

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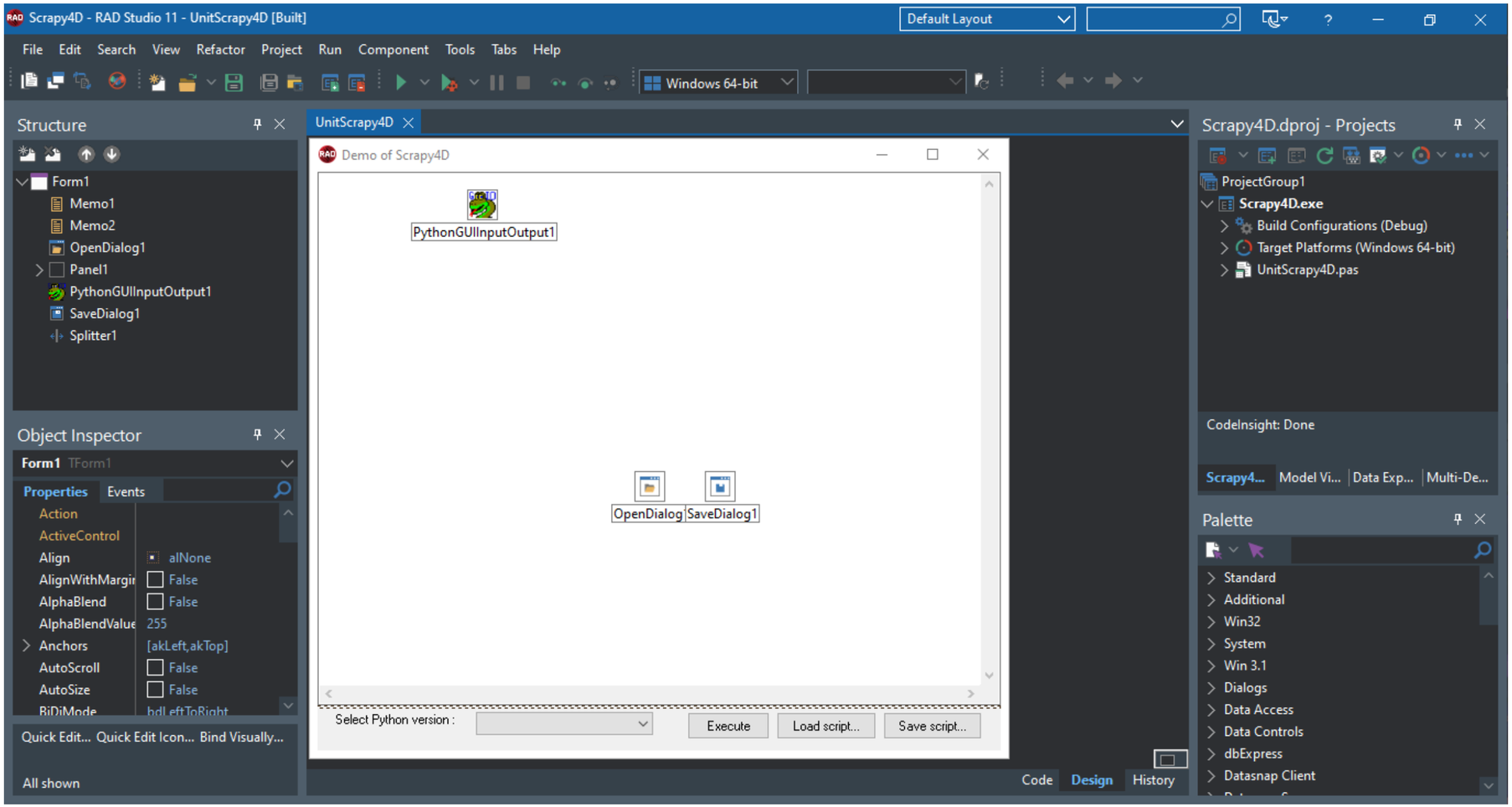

Scrapy Demo

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Scrapy4D - RAD Studio 11 - UnitScrapy4D

Default Layout

File Edit Search View Refactor Project Run Component Tools Tabs Help

Windows 64-bit

Structure

Classes
TForm1(TForm)
PythonEngine1: TPythonEngine
PythonModule1: TPythonModule
PythonType1: TPythonType
PyVersions: TPythonVersions
Public
CreatePythonComponents
Published
Splitter1: TSplitter
Memo1: TMemo

Object Inspector

Form1 TForm1

Properties Events

AlphaBlendValue	255
Anchors	[akLeft,akTop]
AutoScroll	False
AutoSize	False
BiDiMode	bdLeftToRight
BorderIcons	[biSystemMenu,biMini
BorderStyle	bsSizeable
BorderWidth	0
Caption	Demo of Scrapy4D
ClientHeight	526

Quick Edit... Quick Edit Icon... Bind Visually...

All shown

UnitScrapy4D

```
142   PythonType1.OnInitialization := PythonType1Initialization;
143   PythonType1.TypeName := 'Point';
144   PythonType1.Prefix := 'Create';
145   PythonType1.Services.Basic := [bsRepr,bsStr,bsGetAttrO,bsSetAttrO];
146   PythonType1.Module := PythonModule1;
147
148   PythonEngine1.LoadDll;
149 end;
150
151 procedure TForm1.FormCreate(Sender: TObject);
152 var
153   PyVersion: TPythonVersion;
154 begin
155   PyVersions := GetRegisteredPythonVersions;
156   for PyVersion in PyVersions do
157     cbPyVersions.Items.Add(PyVersion.DisplayName);
158   if cbPyVersions.Items.Count > 0 then begin
159     cbPyVersions.ItemIndex := 0;
160     CreatePythonComponents;
161   end;
162   Memo1.Lines.LoadFromFile(ExtractFilePath(ParamStr(0)) + 'scrapyApp.py');
163 end;
164
165 // First, we need to initialize the property PyObjectClass with
166 // the class of our Type object
167 procedure TForm1.PythonType1Initialization(Sender: TObject);
168 begin
169   PythonType1.PyObjectClass := TPyPoint;
170 end;
171
172 // We override the constructors
173
174 constructor TPyPoint.Create( APythonType : TPythonType );
175 begin
176   inherited;
```

1: 1 Insert Delphi UTF8 Code Design History

Scrapy4D.dproj - Projects

ProjectGroup1
Scrapy4D.exe
Build Configurations (Debug)
Target Platforms (Windows 64-bit)
UnitScrapy4D.pas
UnitScrapy4D.dfm

CodeInsight: Done

C:\Users\ASUS\Documents\Embarcadero\Studi...

Scrapy4... Model Vi... Data Exp... Multi-De...

Palette

Delphi | Individual Files
C++Builder | Individual Files
Other | Unit Test
Modeling
Delphi | Multi-Device
Delphi
Delphi | Windows
C++Builder | Windows
C++Builder
C++Builder | Multi-Device

Scrapy Demo

- Set up these paths to your Environment Variable, for Anaconda Python:

```
C:/Users/YOUR_USERNAME/Anaconda3/Lib/site-packages
C:/Users/YOUR_USERNAME/Anaconda3/Lib/site-packages/scrapy
C:/Users/YOUR_USERNAME/Anaconda3/Library
C:/Users/YOUR_USERNAME/Anaconda3/Library/bin
C:/Users/YOUR_USERNAME/Anaconda3/Library/mingw-w64/bin
C:/Users/YOUR_USERNAME/Anaconda3/pkgs
C:/Users/YOUR_USERNAME/Anaconda3/Scripts
```

Scrapy Demo

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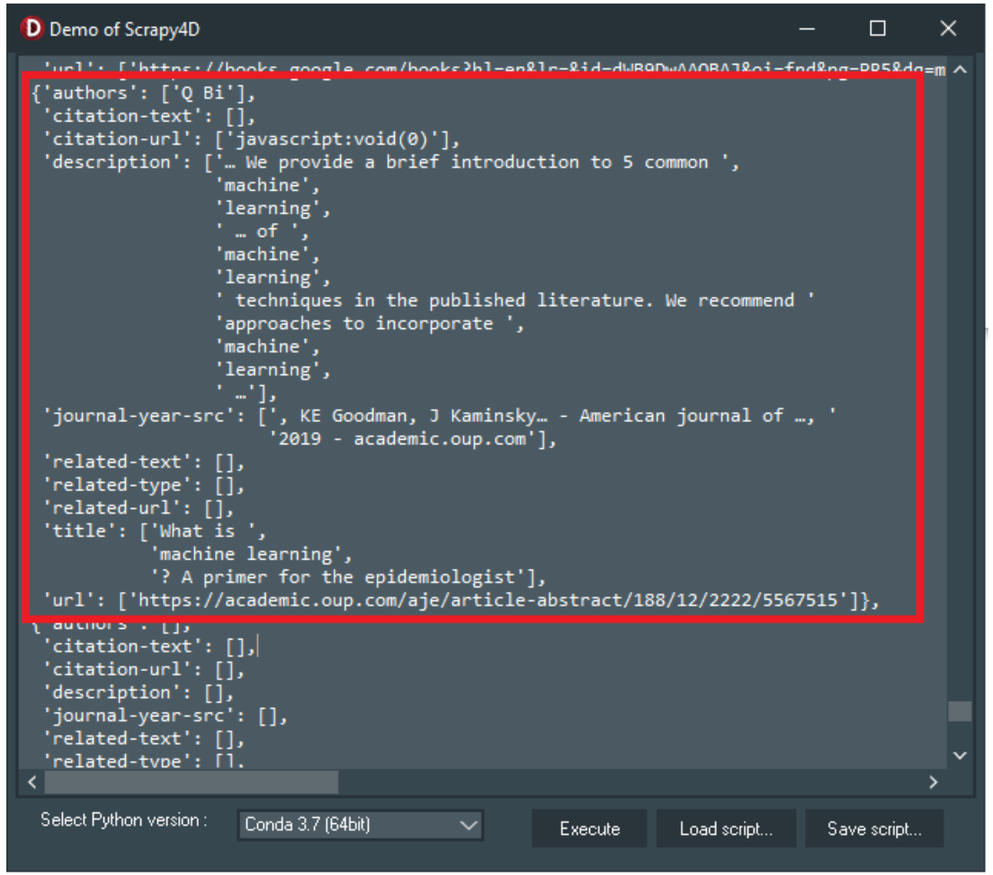
What Scrapy4D Demo do?

- Import the scrapy library and run the basic example, by executing the “scrapyApp.py” on the backend
- Scraping quotes from quotes.toscrape.com
- Scraping titles and URLs from multiple Wikipedia pages at once
- Scraping all Google Scholar search results, for “machine learning” query search
- Read more: https://blogs.embarcadero.com/what-is-the-best-web-scraping-library-for-development-on-windows/



Scrapy Demo

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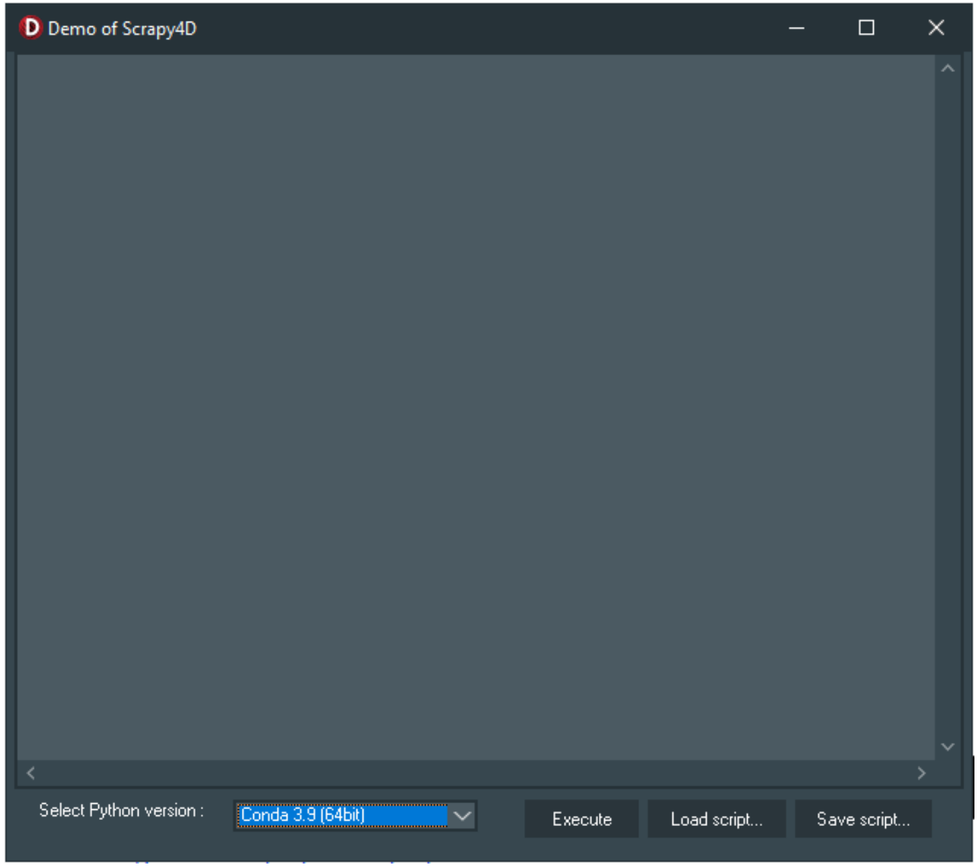
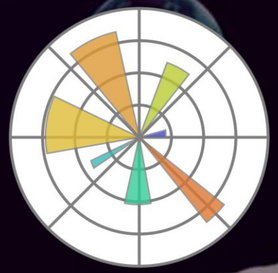
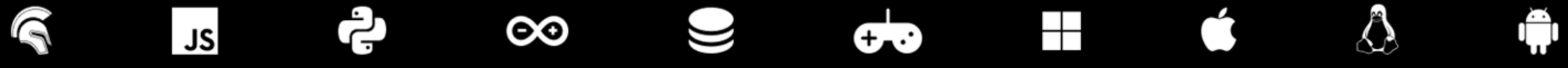
What Next?

- Save the output to JSON, instead of only printing it on TMemo
- For some scenario, we want to save the output into CSV instead of JSON
- And show the output in TStringGrid, instead of Tmemo
- Add NLP capabilities to the GUI
- Your suggestions!



Demo 02: Matplotlib4D, Fastai4D, ScikitLearn4D, NetworkX4D





What is Matplotlib?

- Matplotlib is a comprehensive Python library for creating
  - static,
  - animated, and
  - interactive visualizations.
- Matplotlib produces publication-quality figures in a variety of formats and interactive environments across platforms.

matplotlib Demo

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List of components used in the Matplotlib4D demo app:

*the following component are also used in the Fastai, scikit-learn, and NetworkX demo

1. TPythonEngine
2. TPythonModule
3. TPythonType
4. TPythonVersions
5. TPythonGUIInputOutput
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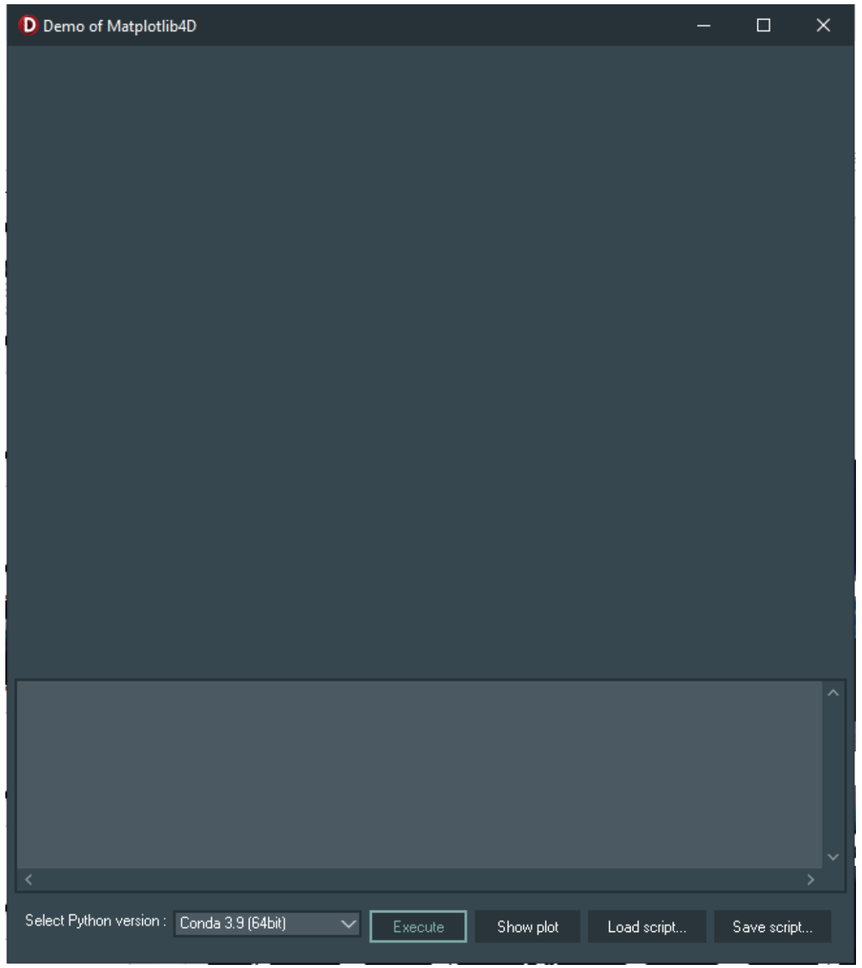
15. TButton



matplotlib Demo

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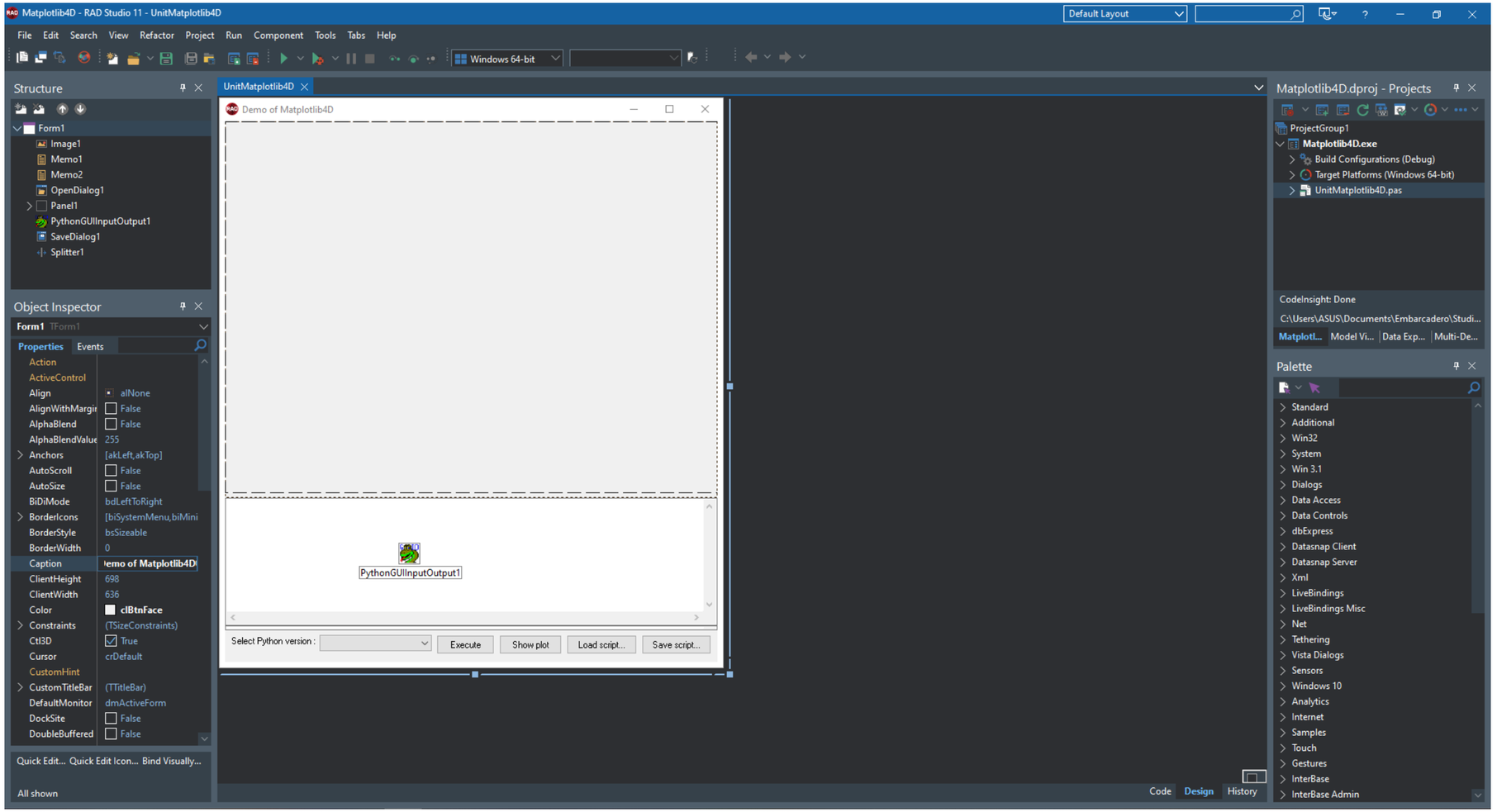

matplotlib Demo

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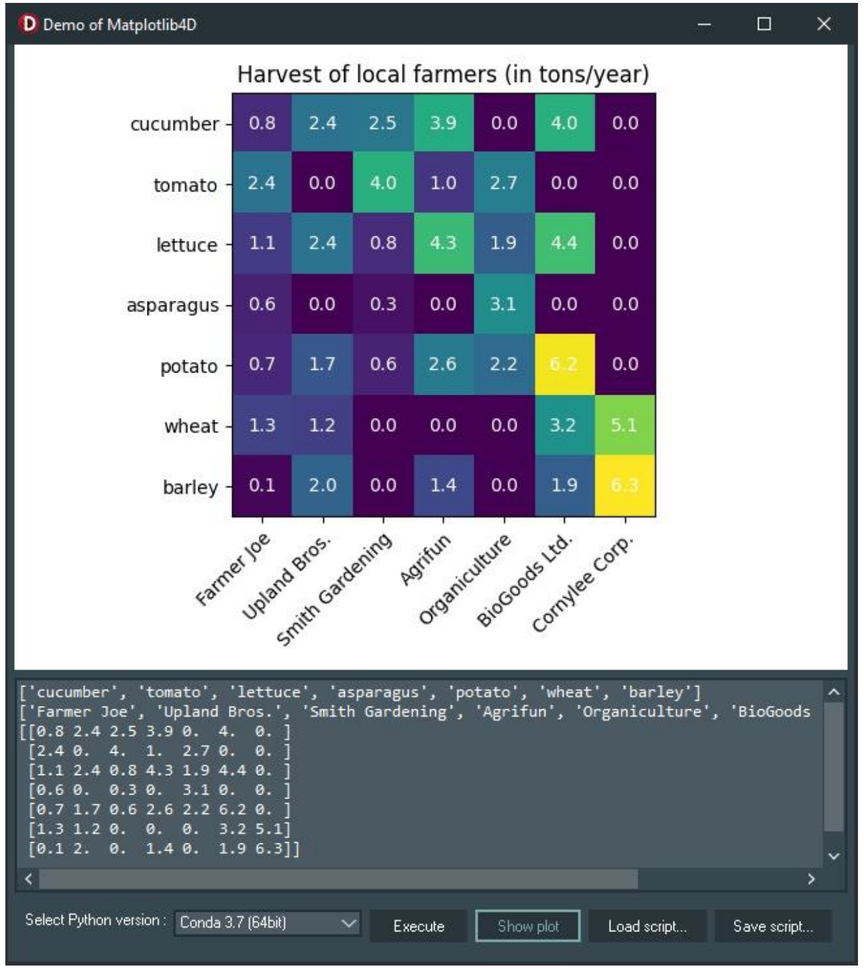
What Matplotlib4D Demo do?

- Import the matplotlib library and run the basic example, by executing the “matplotlibApp.py” on the backend
- Plotting Annotated Heatmap
- Plotting Anatomy of a Figure/Plot
- Read more: https://blogs.embarcadero.com/how-to-make-powerful-data-visualizations-with-matplotlib/



fast.ai

Making neural nets uncool again

Demo

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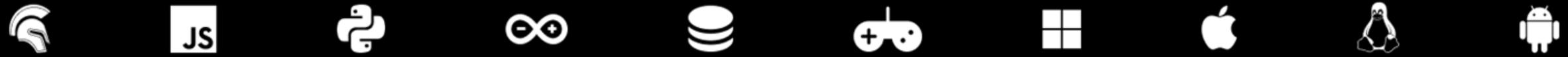
What is fastai?

- fastai is a deep learning library that built on top of PyTorch, one of the leading modern and flexible deep learning frameworks.
- It has a goal to make the training of deep neural networks as easy as possible, and, at the same time, make it fast and accurate using modern best practices.
- It provides practitioners with high-level components that can quickly and easily provide state-of-the-art results
- and provides researchers with low-level components that can be mixed and matched to build new approaches.



fast.ai

Making neural nets uncool again

Demo

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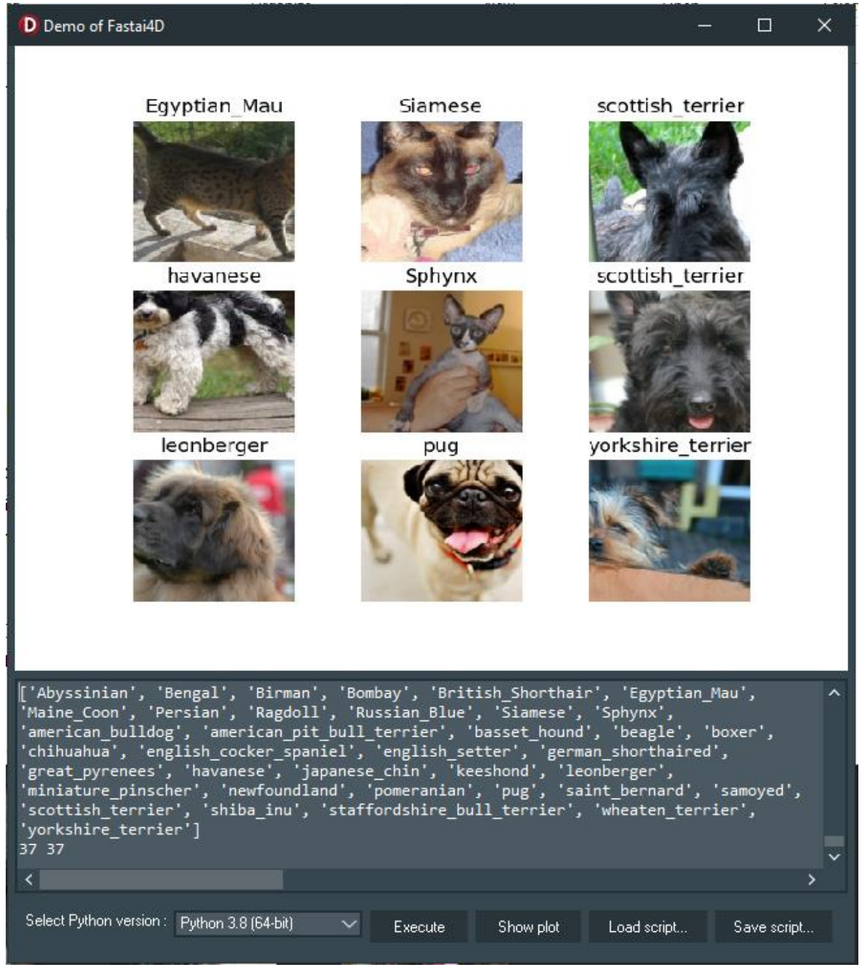
What Fastai4D Demo do?

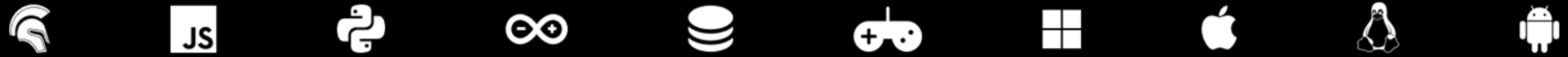
- Import the fastai library and run the basic example, by executing the “fastaiApp.py” on the backend
- Load image datasets with their labels
  - We are going to use the Oxford-IIIT Pet Dataset by O. M. Parkhi et al., 2012 which features 12 cat breeds and 25 dog breeds.
- Train deep learning model (ResNet-34)
- Read more: https://blogs.embarcadero.com/how-to-make-a-state-of-the-art-deep-learning-app-with-fastai/



Demo

What is scikit-learn?

- scikit-learn is an open-source Python machine learning library.
- Simple and efficient tools for predictive data analysis
- Built on top of SciPy, NumPy, and Matplotlib.
- Classification, regression, and clustering
- Among the algorithms available in scikit-learn:
  - Support vector machines
  - Random forests
  - Gradient boosting,
  - k-means
  - DBSCAN, etc.



Demo

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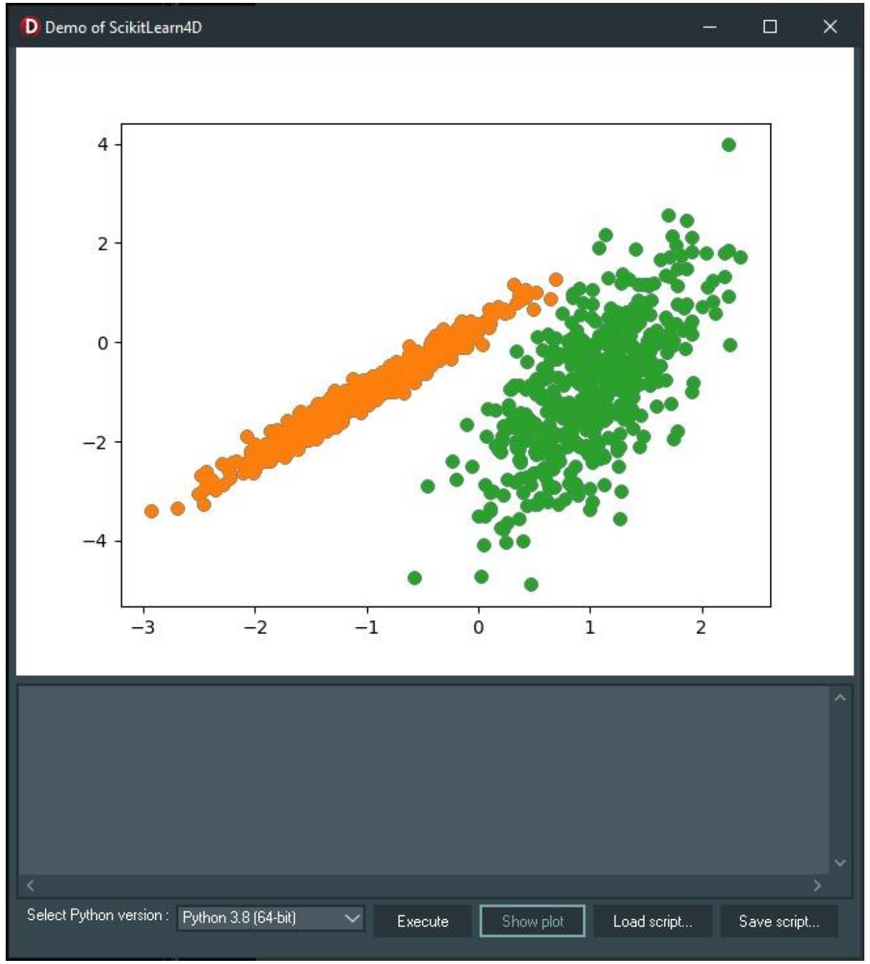
What ScikitLearn4D Demo do?

- Import the scikit-learn library and run the basic example, by executing the “scikitlearnApp.py” on the backend
- Perform 10 Unsupervised Machine Learning algorithms
- Visualize 10 different plots.
- Read more: https://blogs.embarcadero.com/10-unsupervised-machine-learning-algorithms-what-are-they-and-how-to-create-them/



NetworkX Demo

Network Analysis in Python

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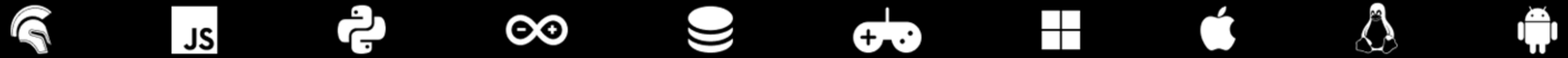
What is NetworkX?

- NetworkX is a Python package for creating, manipulating, and studying complex networks' structure, dynamics, and functions.
- NetworkX provides:
  - tools for studying the structure and dynamics of social, biological, and infrastructure networks;
  - a standard programming interface and graph implementation suitable for a wide range of applications;
  - a rapid development environment for collaborative, multidisciplinary projects;
  - an interface to existing numerical algorithms and code written in C, C++, and FORTRAN; and
  - the ability to work with large nonstandard data sets without difficulty.



NetworkX Demo

Network Analysis in Python

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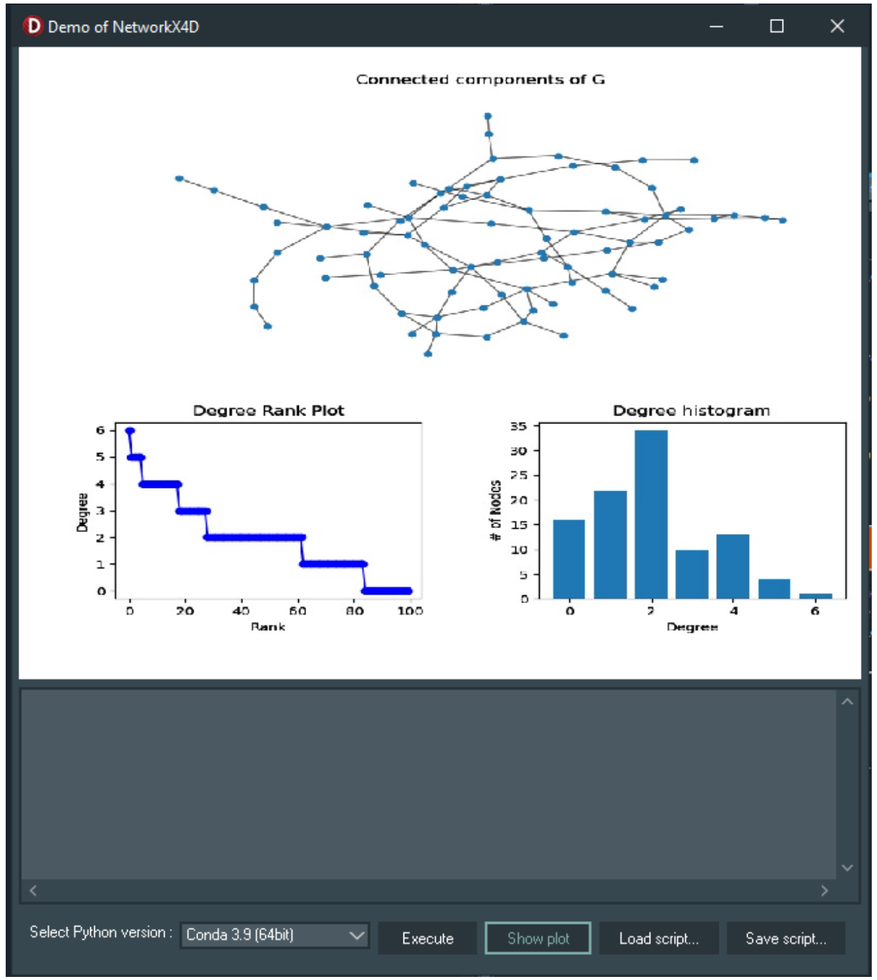
What NetworkX4D Demo do?

- Import the networkx library and run the basic example, by executing the “networkxApp.py” on the backend
- Plotting graphs and networks
- Perform and plotting degree analysis
- Read more: https://blogs.embarcadero.com/what-is-the-best-graphs-and-network-visualization-tool-on-windows/



matplotlib

fast.ai
Making neural nets uncool again

scikit learn

NetworkX
Network Analysis in Python

Demo

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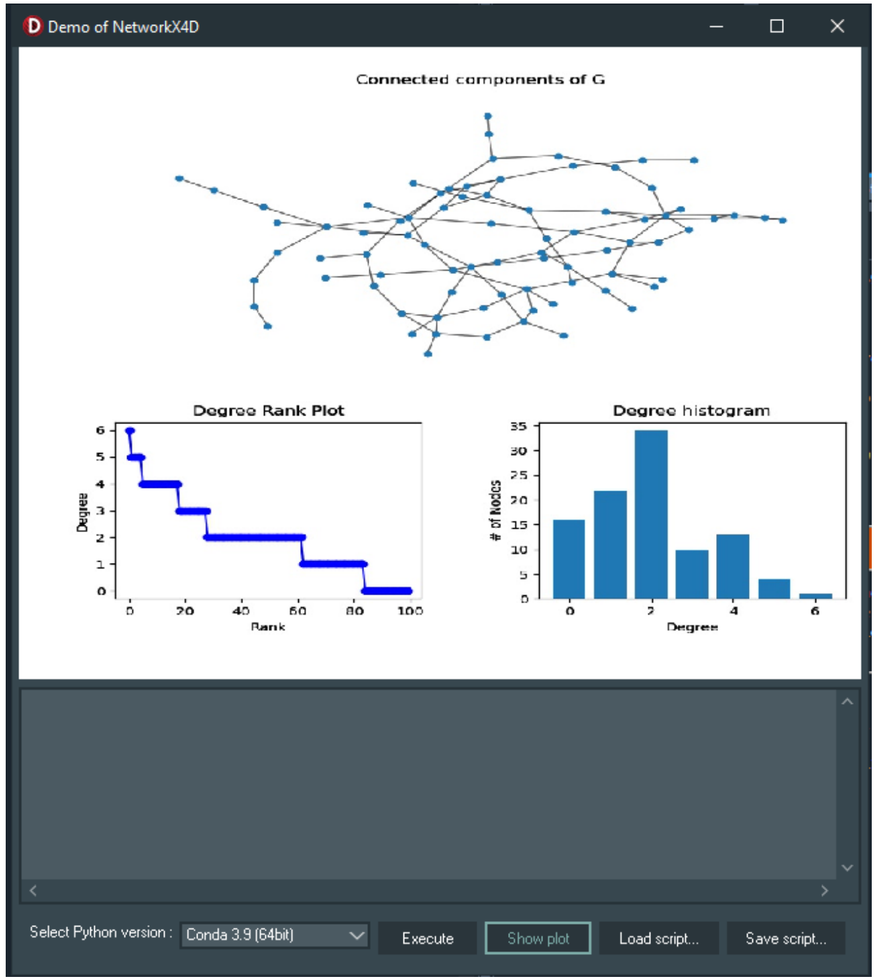
What Next?

- Save/record all the text output, instead of only printing it on TMemo
- Add TStringGrid to present the structured data
- Call the datasets directly from database
- Show multiple image outputs
- Your suggestions!



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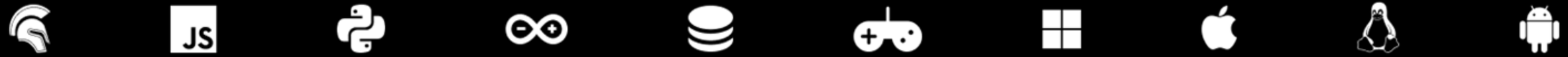
Demo 03: Pandas4D
JS

pandas Demo

What is pandas?

- pandas is a Python package that provides fast, flexible, and expressive data structures designed to work with structured (tabular, multidimensional, potentially heterogeneous) and time-series data easily and intuitively.
- pandas aim to be the fundamental high-level building block for doing practical, real-world data analysis in Python.



pandas Demo

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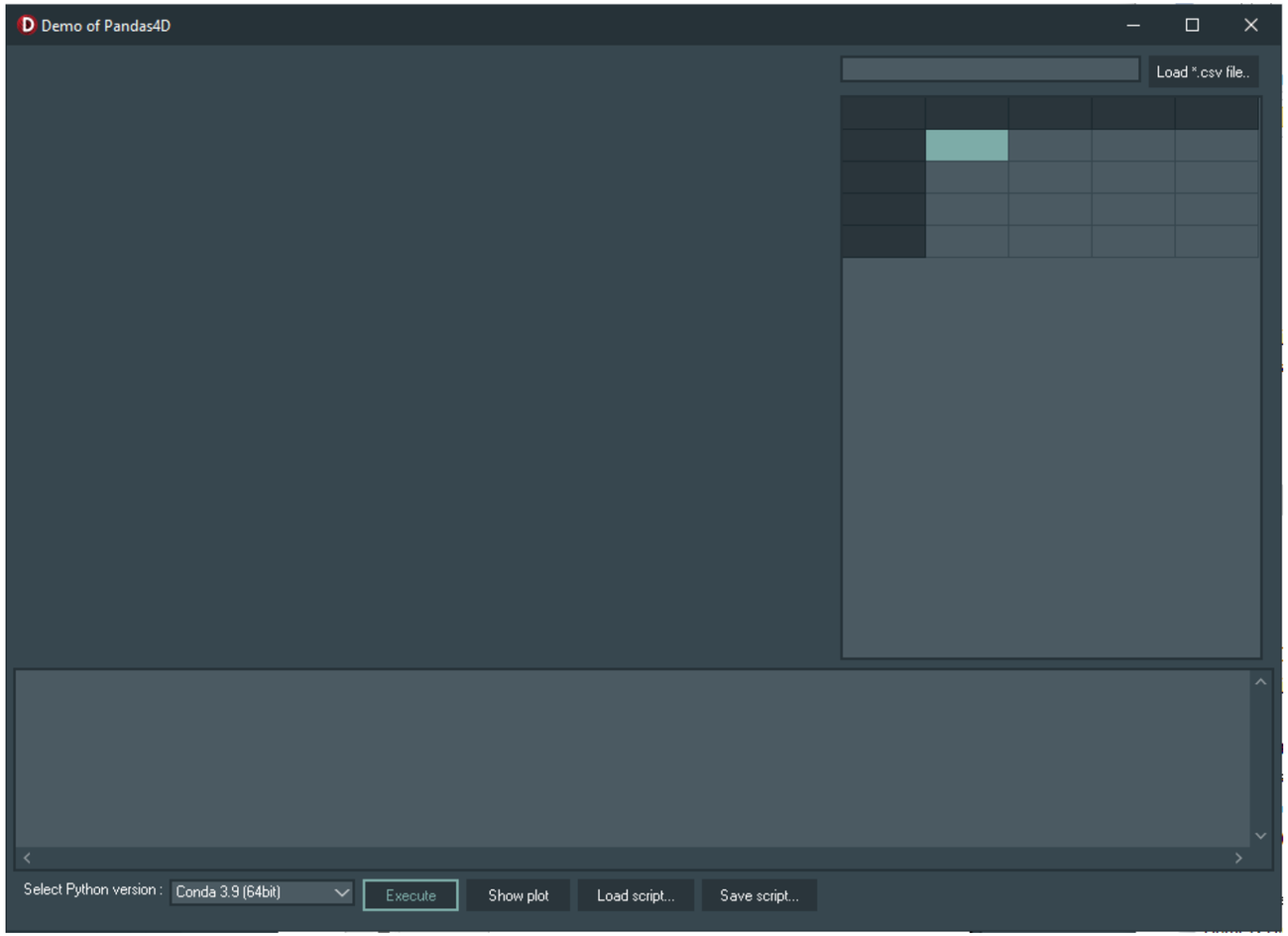
10. TSplitter
11. TImage
12. Tpanel
13. TLabel
14. TComboBox
15. TButton
16. TEdit
17. TStringGrid



pandas Demo

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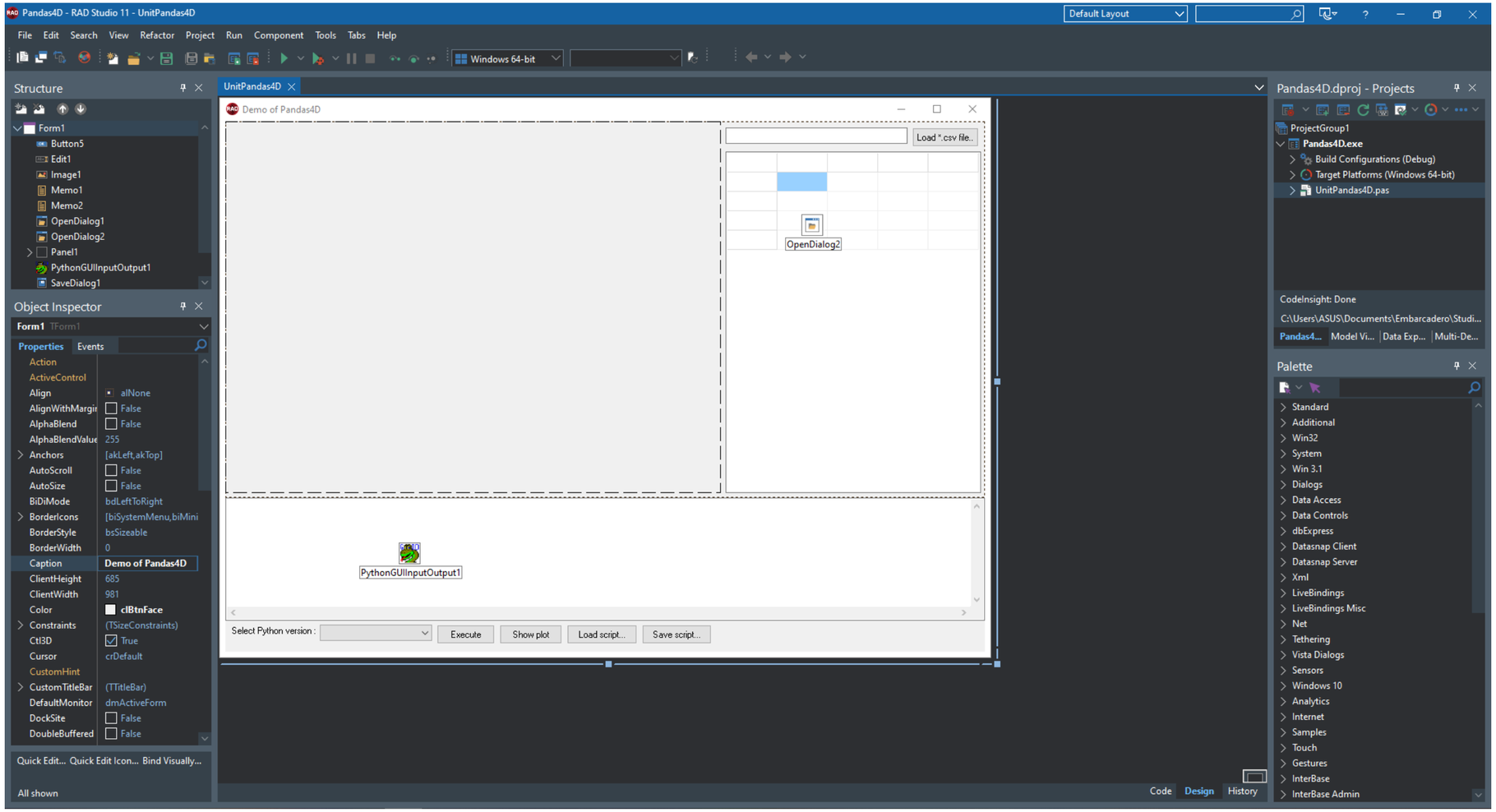

pandas Demo

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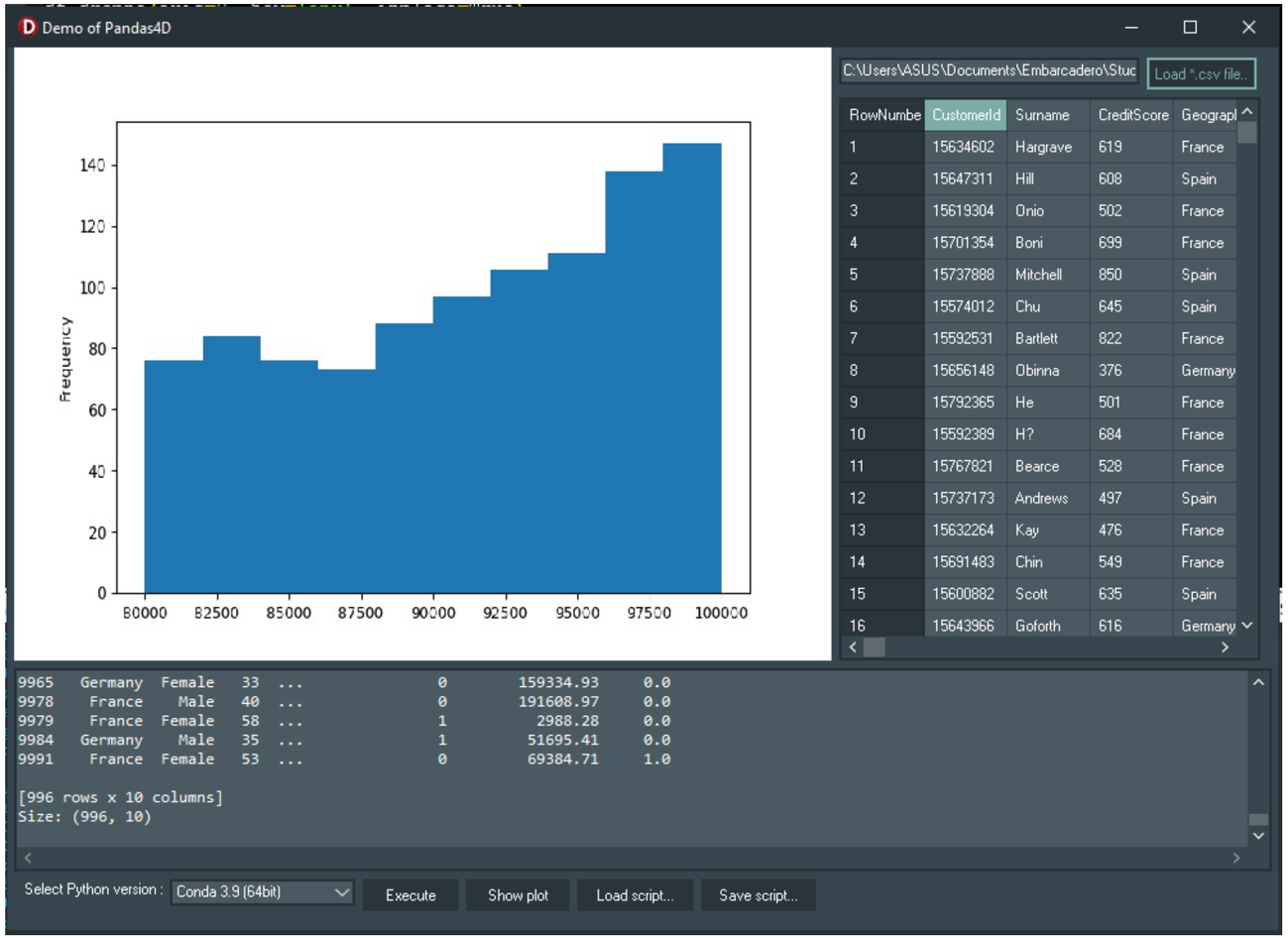
What Pandas4D Demo do?

- Import the pandas library and run the basic example, by executing the “pandasApp.py” on the backend
- Show the dataset on TStringGrid
- Perform 17 data analysis steps
- Produce 2 plots:
  - Histogram
  - Scatterplot matrix
- For the article, stay tune on: https://blogs.embarcadero.com/author/hmazizul/



pandas Demo

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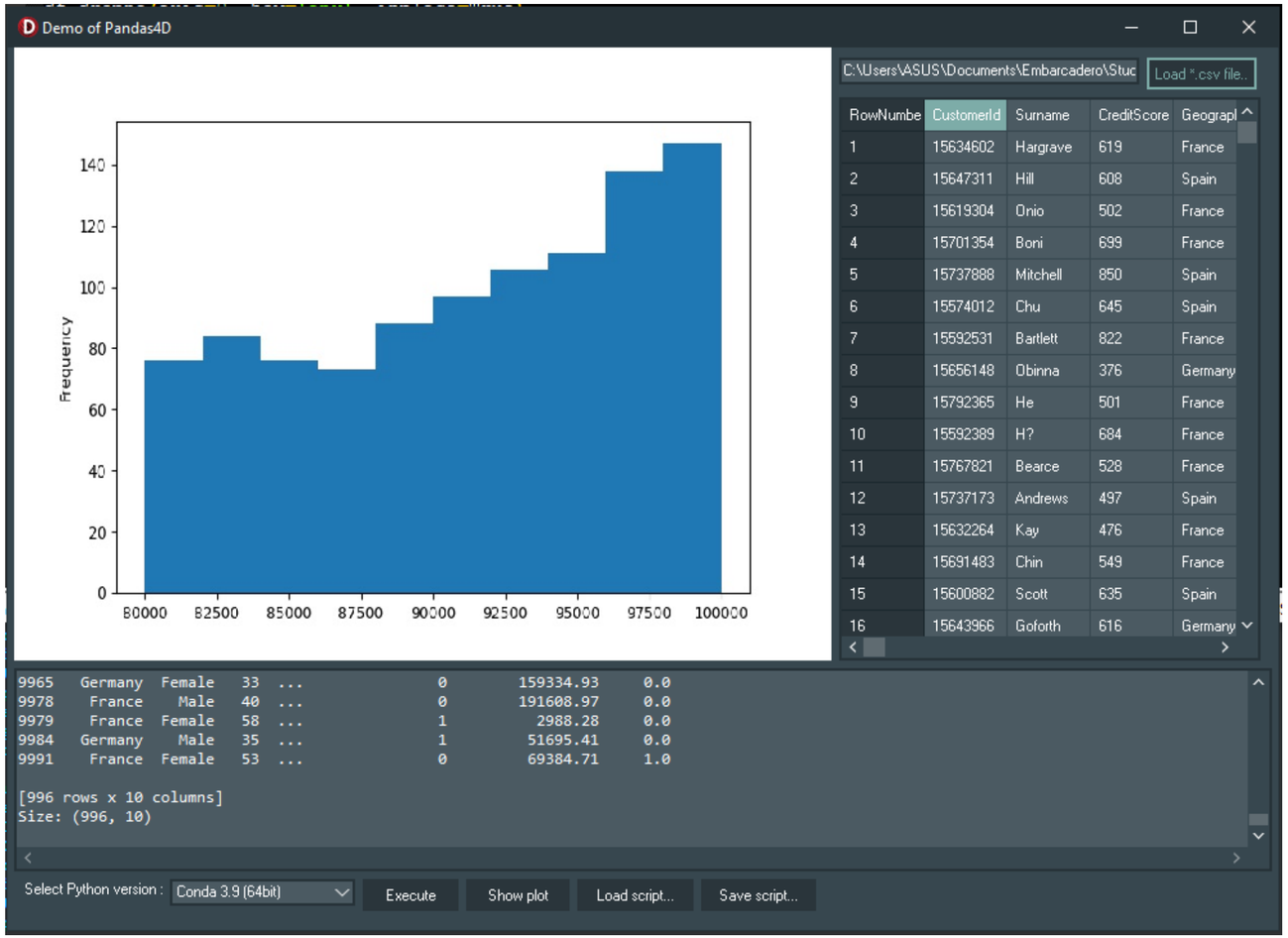
What Next?

- Save/record all the text output, instead of only printing it on TMemo
- Create more dynamic tables using TStringGrid to present the output, instead of TMemo
- Call the datasets directly from database
- Show multiple image outputs
- Your suggestions!



Further Readings

- What Is The Best Web Scraping Library For Development On Windows? https://blogs.embarcadero.com/what-is-the-best-web-scraping-library-for-development-on-windows/
- How To Make Powerful Data Visualizations With Matplotlib https://blogs.embarcadero.com/how-to-make-powerful-data-visualizations-with-matplotlib/
- How To Make A State-Of-The-Art Deep Learning App With Fastai https://blogs.embarcadero.com/how-to-make-a-state-of-the-art-deep-learning-app-with-fastai/

Further Readings

- 10 Unsupervised Machine Learning Algorithms: What Are They And How To Create Them
  https://blogs.embarcadero.com/10-unsupervised-machine-learning-algorithms-what-are-they-and-how-to-create-them/
- What Is The Best Graphs And Network Visualization Tool On Windows?
  https://blogs.embarcadero.com/what-is-the-best-graphs-and-network-visualization-tool-on-windows/
- Powerful Data Analysis And Manipulation Using Pandas Library In A Delphi Windows App
  https://pythongui.org/powerful-data-analysis-and-manipulation-using-pandas-library-in-a-delphi-windows-app/

Further Readings

- Learn To Work With Real-World Graphics Using The Python Matplotlib Library In A Delphi Windows App
  https://pythongui.org/learn-to-work-with-real-world-graphics-using-the-python-matplotlib-library-in-a-delphi-windows-app/
- Build A Machine Learning Solutions With Scikit-Learn Library In A Delphi Windows App
  https://pythongui.org/build-a-machine-learning-solutions-with-scikit-learn-library-in-a-delphi-windows-app/
- Draw Visually Stunning Networks In Your Python GUI App Using NetworkX Python Library
  https://pythongui.org/draw-visually-stunning-networks-in-your-python-gui-app-using-networkx-python-library/

Further Readings

- Learn To Build A GUI For These 10 Ultimate Python AI Libraries
  https://pythongui.org/learn-to-build-a-gui-for-these-10-ultimate-python-ai-libraries/
- Introduction to Python GUI Development with Delphi for Python - Part 1: Delphi VCL for Python
  https://www.youtube.com/watch?v=m0r80fxZWPI
- PyTorch for Delphi with the Python Data Sciences Libraries - Webinar Replay
  https://www.youtube.com/watch?v=IJB-Hx_Gi1M&t=371s
- Getting Started with Python4Delphi
  https://www.youtube.com/watch?v=hjY6lBgrHhM&t=10s
- Python4Delphi Demos
  https://github.com/pyscripter/python4delphi/tree/master/Demos

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Thank you!

Get the code:
`github.com/Embarcadero/CodingBootCamp2022`